

# ActionPac Technical Notes

## TECHNICAL NOTES: RESOLUTION, RANGE, CAPACITY, ACCURACY

1. DISPLAYED RESOLUTION is the readable, stable, repeatable digital display.
2. INTERNAL RESOLUTION is the number of increments the software/hardware combination can read.
3. COMBINED LOAD –“ Dead load” automation hardware such as weigh bucket, plus the inertial load (opening and closing weigh bucket, as well as product drop inertia), plus net weight of product.
4. ACCURACY, for the purposes of automation, is what you get in the bag/box/vial etc. and is a factor of internal resolution X environmental and product factors. It is also the only meaningful specification for purposes of guarantees (see “performance guarantee” attached).
5. LVT or linear voltage transducer. Also referred to as force restoration, the concept requires that a load be applied to an armature tied to a flexure assembly. The armature’s position in a magnetic coil is then restored by the application of voltage to the coil. The voltage required to restore the armature to its original position is measured and digitized. The advantages are high resolution (105 typical) under ideal (laboratory) conditions. The disadvantages are: Clumsy mounting hardware in automation applications.
  - Slow response time.
  - Fragility.
  - High initial expense.
  - Extreme non-linearity in non-level conditions.
  - High maintenance requirements.
6. SETRA “LOAD CELL” (ceramic capacitance) sensor. Developed by Dr. Lee of Setra corporation decades ago and licensed to Mettler. The name is the description. High resolution (to 107) and easier to use in automation than LVT. The disadvantages are:
  - Some fragility due to the brittleness of the ceramic design.
  - Some leveling requirements.
  - High initial, repairs and maintenance costs (must be tuned in vacuum chamber).
  - High frequency harmonics sensitivity.

7. K-TRON "TUNING FORK". A wire is vibrated, under controlled conditions, weight is applied, and the vibration frequency is measured. Good resolution (to 106 internal). The disadvantages are:

- Extremely bulky.
- Clumsy automation hardware.
- Slow response time.
- Some fragility.
- Initial expense.
- Repairs factory only - cost higher than new unit.

8. LOAD CELL (STRAIN GAUGE). 10-15 VDC input, through fine wires (strain gauges) cunningly glued to various locations on body of cell (usually aluminum) to compensate for side load, non level conditions, etc. The body of load cell bends, fine wires change conductivity output (in microvolts). This analog is then measured, converted to (in our case) frequency, then digitalized. High durability, low cost, easy to calibrate, low maintenance, low replacement costs, relative insensitivity to level conditions. The disadvantages are:

- Comparatively low resolution in industrial applications (104 typical, 5X104 with sophisticated instrumentation\*, 105 with elaborate amplification, digital filters, 3-10 second response).

### **Example (Load Cell)**

Assume a custom high precision 500 gram load cell with 150% safe overload. Then assume a 250 gram dead load (weigh bucket hardware). The maximum resolution would be .002% of 500 gram or 1/100 gram. That's pushing it, but possible if great care is taken. However, actual accuracy under normal operating conditions could not be guaranteed to be greater than .025 grams; i.e., +/- .01 accuracy could be achieved but expect +/- .02.

\*Like ours